UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/785,858	02/16/2001	Shane P. Leiphart	MI22-1636	7367

21567 7590 12/01/2005

WELLS ST. JOHN P.S.
601 W. FIRST AVENUE, SUITE 1300
SPOKANE, WA 99201

EXAMINER	
CANTELMO, GREGG	
ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 12/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

MAILED

DEC 01 2005

GROUP 1700

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/785,858
Filing Date: February 16, 2001
Appellant(s): LEIPHART, SHANE P.

Jennifer J. Taylor
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed September 14, 2005 appealing from the Office action mailed April 26, 2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

No evidence is relied upon by the examiner in the rejection of the claims under appeal.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 35-39, 41-45 and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser in view of Shan, Colgan and Marieb, all of record and for the reasons of record.

Besser discloses a method of sputtering (a PVD process) aluminum or aluminum alloy films on a semiconductor, then sputtering a titanium film on the aluminum layer while reacting the titanium with the aluminum to deposit a titanium alloy layer on the aluminum, and thereafter sputtering a titanium nitride film on the alloy layer. The titanium is deposited on the first layer of aluminum or aluminum alloy in a second processing chamber 230 and when maintaining the upper temperature for processing the titanium, the deposition will result in essentially all of the titanium alloying with the aluminum during deposition of the titanium which effectively then is a deposition of a titanium alloy layer (abstract; col. 3, ll. 5-24; col. 4, ll. 13-51 as applied to claims 35, 49 and 58).

During the deposition of the titanium layer the film is heated to approximately 350°C and by teaching of an upper limit of 450 °C, can also be set above 360°C (paragraph bridging columns 3 and 4). After completion of the films on the substrate, the substrate is removed from the tool to allow for the processing of additional substrates. The titanium layer is deposited to 100 angstroms (col. 4, ll. 22 as applied to claims 36 and 37).

The first layer can be either aluminum or an aluminum alloy (col. 3, ll. 12-15 as applied to claims 38 and 39).

The titanium and titanium nitride layers are formed in the same chamber 230 (col. 4, ll. 12-15 and 29-33 as applied to claim 42).

The titanium is deposited on the first layer of aluminum or aluminum alloy in a second processing chamber 230 and when maintaining the upper temperature for processing the titanium, the deposition will result in essentially all of the titanium alloying with the aluminum (as applied to claim 43).

The differences between the instant claims and Besser are that Besser does not disclose forming the outermost portion of the aluminum layer at a temperature of 400°C or more (claim 35); or of preventing the outermost portion from cooling below 360°C during deposition of the first titanium layer (claim 35); or of forming the layers into a conductive line (claim 35); of providing a substrate having an opening extending through an insulating layer to a diffusion region (claim 35); of forming the outermost portion of the aluminum layer at a temperature of 360°C or more during the deposition of the third layer (claim 41); of the first deposition temperature being at least 450° C (claim 44); of the first deposition temperature being greater than 450°C (claim 45), providing an insulative material over the substrate, forming a contact opening within the insulative material and depositing the underlayer/wetting layer and first aluminum layer over the substrate (claims 35 and 75).

With respect to forming the outermost portion of the aluminum layer at temperatures of at least 360°C and at least 400°C (claims 35 and 41):

Shan teaches that the remainder of the metal is deposited while the semiconductor wafer is held at a relatively high temperature (e.g., when the metal is an aluminum alloy, about 400°C. to about 500°C which allows the deposited metal to reflow through grain. The hot aluminum deposition can be continued until a fully planarized surface is obtained.

The motivation for depositing the outermost portion of the aluminum at temperatures of at least 400°C is to provide reflow of the aluminum film.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser by depositing the outer portion of the aluminum at a temperature of at least 400°C since it would have allowed the deposited metal to reflow through the grain and provided optimal conditions for forming a planarized aluminum film.

With respect to preventing the temperature of the outermost portion of the aluminum film from going below 360°C (claims 35, 44, and 45):

As discussed above, Besser teaches that the titanium is heater within a range from 25°C to 450 °C, with an approximate exemplified temperature of 350°C. Besser also recognized that the Ti reacts with Al to form TiAl3 (col. 4, ll. 24-29). It is also known that maintaining temperatures of greater than 350°C will ensure reaction between titanium and aluminum to readily form TiAl3. Marieb discloses sputtering titanium over the aluminum layer and that heating the device from a range of about 350°C-450° C accelerates the reaction between the titanium and aluminum to form the

desired TiAl3 product. The thickness of the film can be optimized so that all of all of the titanium film is reacted (col. 4, ll. 3-20).

Thus it would have been obvious to maintain the temperature to be greater than 350°C, held to be about 360°C, since it would have provided requisite temperature conditions to react the depositing titanium with the aluminum. TiAl3 increases the electromigration lifetime of the film.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser by ensuring that the temperature of the first layer does not go below about 360°C during deposition of the titanium since it would have provided optimal temperature conditions wherein the depositing titanium would have reacted with the aluminum to form a layer of TiAl3. Such a layer being known to have increased the electromigration lifetime of the multilayer device.

With respect to sustaining the temperature of the aluminum to be at least 360°C between the depositing of the first layer and the titanium or titanium alloy:

The combined teachings of Besser and Marieb teaches that it in order to react the aluminum with the titanium to firm TiAl3, the temperature of substrate must be in a range of about 350-450°C.

Shan further teaches that heating the aluminum to temperatures between 400°C and 500°C is desirable to allow the aluminum metal to flow through the grains and form a planar surface.

In applying the teaching of Shan to that of Besser, it would have been obvious to heat the aluminum layer to temperatures between 400°C and 500°C to allow the aluminum metal to flow through the grains and form a planar surface on the substrate.

Thereafter, in transferring the aluminum coated substrate at the desired temperature disclosed by Shan into the adjacent titanium deposition chamber, the transfer time of the Endura 5500 (the same one used by both Besser and the instant application) is not sufficiently long enough to cause the temperature to significantly decrease.

Even further, Marieb teaches that the deposition temperature of titanium on the aluminum layer must be 350°C-450°C to cause formation of TiAl3. It would not have been obvious to permit the aluminum layer to cool below the minimum temperature required for the formation of TiAl3 in the adjacent deposition step since it would have reduced the throughput of the system by requiring an additional heating step prior to depositing the titanium. Furthermore maintaining the aluminum at the temperature specified by Shan ensures the planarization of the aluminum layer immediately prior to the titanium deposition.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser in view of Shan and Marieb by maintaining the aluminum-coated substrate at a temperature of at least 360°C between the aluminum and titanium deposition steps since it would have maintained the aluminum planarization temperature immediately prior to forming the titanium layer and prevented the need for an additional heating step by keeping the

temperature of the substrate in the same range acceptable for both deposition processes. In addition it is held that the Endura 5500 deposition chamber used by both Besser and the instant application has a substrate transfer rate which is sufficiently short enough to prevent substantial cooling of wafers between deposition chambers.

With respect to photopatterning the layers to form a conductive line (claim 35):

Colgan discloses forming an interconnect for a semiconductor device where an aluminum alloy film is sputtered on a substrate, with subsequent Ti and TiN sputtered in succession. The layers are then photolithographically etched to form pattern lines (Col. 2, line 62 through col. 3, line 7; col. 4, ll. 34-40).

After depositing the multilayer structure Shan photopatterns the layers into a conductive line (see Example 1).

The motivation for patterning the deposited layers is to form wiring patterns useful in interconnect structures.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser by patterning the deposited layers as taught by Colgan and Shan since it would have formed wiring patterns for forming interconnects.

With respect to providing an insulative material over the substrate, forming a contact opening within the insulative material and depositing the underlayer/wetting layer (i.e., the first layer) and first aluminum layer over the substrate and insulating layer and filling the openings (claims 35 and 75):

Besser discloses forming a titanium underlayer on the substrate prior to forming the aluminum layer (col. 3, ll. 10-15). The underlayer is equivalently understood in the art to be a wetting layer. The process is designed for fabrication of semiconductor devices (col. 1, ll. 20-25). Furthermore the multilayer structure disclosed therein is for vias or contacts in semiconductor devices (see col. 1, ll. 22-57 and col. 5, ll. 7-19). Contact opening or vias are commonly formed in insulating layers of a semiconductor device and provide electrical contact between adjacent layers.

Typical semiconductor substrates include forming providing an insulative material over the substrate, forming a contact opening within the insulative material and depositing the underlayer/wetting layer and first aluminum layer over the substrate as evident from the instant applications prior art admission (page 1).

Shan teaches of metallization of semiconductor layers includes providing a dielectric layer 1 on a substrate 7, forming contacts or vias in the substrate and thereafter depositing the multilayer metallization layers 3-8 on the substrate (col. 1, ll. 10-20 and Fig. 1).

The motivation for providing the substrate arrangement of Shan is that it provides an initial insulating layer between the substrate and metallization layers and provides an insulative material for forming contacts or vias on the substrate surface.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser by providing the substrate arrangement of Shan since it would have provided an initial insulating layer

between the substrate and metallization layers and provided an insulative material for forming contacts or vias on the substrate surface.

Claims 46-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser in view of Shan, Colgan and Marieb as applied to claims 35-39 and 41-45 above, all of record and for the reasons of record.

The difference not yet discussed is cooling the outermost portion of the first layer from the first deposition temperature by about 25°C or less (claims 46-48).

The claim limitations include a cooling by zero degrees (or less).

Besser forms the claimed structure and recognized the applicability of temperature ranges for the deposition of titanium from 250-450°C. Furthermore to change the titanium sputtered material to TiAl3 it is advantageous to set the deposition temperature to be from 350-450°C to increase the electromigration lifetime of the device (Marieb). Shan also teaches that temperatures of 400-500°C are desirable when forming the outer portion of an aluminum film to provide adequate reflow of the aluminum to reduce void formation and form planar films.

Thus it would be apparent to form the aluminum film outer portion in a range of 400°-500°C as taught by Shan and thereafter form the titanium film in a range of 350°C-500°C. Noting an overlap of these ranges, one of ordinary skill would have further found it obvious to use temperatures that overlap to provide optimal conditions with which both films can be formed without the need for changing process variables. Thus a temperature near or about that which both of these films can be deposited to achieve

the desired result would have been preferred to reduce the process time required for setting different temperature conditions.

In addition the limitations set forth in claims 46-48 are drawn to particular ranges of temperatures and does not appear to provide any novel effect not achieved by the process conditions set forth in the prior art of record.

Generally, differences in ranges will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such ranges is critical. In re Boesch , 617 F.2d 272, 205 USPQ 215 (CCPA 1980). In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969).

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser such that any temperature relationship between the first and second films was applied so long as the temperatures achieved the same resultant multilayer device as formed by the prior art of record above. Furthermore, it has been held that when the difference between a claimed invention and the prior art is the range or value of a particular variable, then a prima facie rejection is properly established when the difference in the range or value is minor. Titanium Metals Corp. of Am. v. Banner, 778 F.2d 775, 783, 227 USPQ 773, 779 (Fed. Cir. 1985).

(10) Response to Argument

Note -

It should be evident, from a review of the prosecution history that the depth of this argument has not been provided at any point prior to Appellant's filing of this Appeal Brief. Appellant is now presenting a substantially new number of arguments within this Appeal Brief.

Argument I - Appellant argues on page 9 of the Appeal Brief that:

"Nothing in Colgan contributes toward suggesting the claim 35 recite formation of a first layer comprising aluminum over an insulating layer and filling an opening which extends through the insulating layer"

Appellant's arguments are not persuasive for the following reasons:

First, the fact that Appellant argues that Colgan does not teach features of the claim is not germane to the rejection because Colgan is not being relied upon to teach or suggest the features identified in Appellant's statement above.

Second, this argument fails to take present any reasonable rebuttal to the rejection of Besser in view of Colgan as presented in the prior art rejection of record. In the case of the particular claim limitations of note, Colgan is provided to show that the concept of photopatterning integrated circuits is a conventional technique known to one of ordinary skill in the art. Therefore the argument is held to be a piecemeal analysis of the Colgan reference. In response to Appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Thirdly, it should be further noted that photopatterning interconnects is recognized in the instant application as being a known prior art technique (see page 2, line 20).

The motivational statement set forth above in the prior art rejection of record, states that the motivation for patterning the deposited layers is to form wiring patterns useful in interconnect structures.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Besser by patterning the deposited layers as taught by Colgan and Shan since it would have formed wiring patterns for forming interconnects.

For at least these reasons the rejection should be maintained.

Argument II(A)- Appellant argues that Marieb does not suggest or contribute toward suggesting the specifically recited depositing of the outermost portion of the Al-comprising layer at the recited temperature or the recited sustaining temperature of the Al-comprising layer prior to Ti deposition. Rather, Appellant argues that Marieb discloses heating the coated substrate after formation of the multilayer structure to form the $TiAl3$ reaction product and further does not teach of depositing Al at the recited temperature and sustaining the Al temperature above at least about 360°**C** prior to Ti deposition.

This specific argument is newly presented in Appellant's Appeal Brief.

However such arguments are misleading in that they fail to address the construct in which Marieb is applied. First, a review of the prior art rejection of record should

show that it is the combination of Besser in view of Shan, and not Marieb, which addresses the limitations of depositing of the outermost portion of the Al-comprising layer at the recited temperature or the recited sustaining temperature of the Al-comprising layer prior to Ti deposition. Therefore any arguments to such would not be particularly relevant to the manner in which Marieb is applied.

Again, as has been the case throughout most of the prosecution history of the instant application, the arguments directed to Marieb are a piecemeal analysis of this reference. In response to Appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

As described in the rejection, Besser discloses a method of sputtering (a PVD process) aluminum or aluminum alloy films on a semiconductor, then sputtering a titanium film on the aluminum layer <u>while reacting the titanium with the aluminum</u> to deposit a titanium alloy layer on the aluminum, and thereafter sputtering a titanium nitride film on the alloy layer.

The process steps of Besser include:

Step B - deposit and aluminum or aluminum alloy in chamber 220 (col. 3, ll. 10-15 of Besser).

Step C - deposit Ti in chamber 230 (col. 3, ll. 16-20 and col. 4, ll. 12-28 of Besser), in the presence of heated argon during the deposition process, wherein during

the process, $TiAl_3$ is formed (col. 4, ll. 12-28). The deposition temperature range for depositing the titanium is in a range from 25-450°C (see col. 4, line 2) and preferably 350°C (see col. 3, ll. 65-67). Further given the evidentiary teachings of Marieb, that $TiAl_3$ formation is achieved at temperatures from 250°C-450°C, it is held that the lower limit of Besser (25°C) is a typographical error and is in fact 250°C. The formation of $TiAl_3$ is not known to be achieved at 25°C (near room temperature at STP) providing further evidence as to why this lower limit is in err.

From the teachings of Besser then it would be reasonable to assert that one of ordinary skill in the art would have employed the titanium deposition at a temperature from 250°C to 450°C to react the aluminum with titanium and form $TiAl_3$.

Like Besser, Marieb discloses that $TiAl_3$ can be formed by reaction of Al and Ti in a temperature range from 250°C to 450°C. While it is held that the range of 25°C-450°C of Besser is actually 250°C-450°C, in the least this range would have been inherent else obvious in view of the teachings of Marieb to generate the $TiAl_3$ reaction layer described in column 4, line 28 of Besser.

Further, Marieb provides a suggestion that depositing the titanium at a range from 350°C to 450°C provides an advantage of accelerating the reaction between the titanium and aluminum. Therefore the Examiner asserts that the prior art of Besser in view of Marieb provides clear reasons for depositing the titanium at a temperature range from 350°C to 450°C onto the aluminum since it would have accelerated the $TiAl_3$ reaction desired in the Besser disclosure.

From the combined teachings of Besser in view of Marieb, there is a reasonable and logical teaching for application of a preferred temperature from about 350-450deg C during the titanium deposition step of Besser to accelerate the reaction formation of $TiAl_3$.

With respect to the arguments to heating and maintaining the outermost portion of the Aluminum layer as required by the claims, the rejection relies on Besser in view of Shan and Marieb, which is provided to suggest application of such temperatures and the rebuttal below is incorporated herein for purposes of brevity.

For at least these reasons, the Examiner maintains the prior art rejections of record.

Argument II(B)- Appellant argues that the Examiner's statement in the first paragraph of page 7 is in error.

This argument is presented for the first time in Appellant's Appeal Brief. While Marieb may not teach that the temperature of must be in the range of 350°C-450°C, Marieb does provide motivation for using this range to *accelerate the reaction between the aluminum and titanium, and* the Final office action recognized this (see page 5, ll. 7-11 of the Final Office). Whether or not Marieb explicitly limits to 350°C-450°C or not is not a persuasive argument when it is apparent that Marieb still provides motivation for using this range in order to accelerate the reaction between the Aluminum and Titanium. Therefore it still would have been obvious to one of ordinary skill in the art to employ the temperature range of 350°C-450°C as a preferred range since it would have

accelerated the reaction between the aluminum and titanium as expressly taught by Marieb.

Using the higher temperature to accelerate the reaction would have reduced the processing time for the substrate and increased the throughput of the processing system and apparatus. All of which would have been readily apparent to one of ordinary skill in the art given the teachings and suggestions of the prior art rejection of record.

Argument II(C)- Appellant also argues that Marieb does not contribute toward suggesting the claim 35 recited formation of such aluminum-comprising layer over an insulating layer and filling an opening through the insulating layer.

As is the case with Colgan, Appellant again takes a piecemeal analysis of Marieb once more stating what Marieb fails to teach in this argument without acknowledging or recognizing that Marieb is not relied upon for those particular features and therefore need not teach all claim limitations.

In response to Appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

For at least these reasons, the Examiner maintains the prior art rejections of record.

Argument III (A)- Appellant argues that combination of Shan in view of Besser fails to reasonably teach or suggest Appellant's claimed invention.

This specific argument is newly presented in Appellant's Appeal Brief.

Appellant goes into detail with respect to what Shan does and does not teach but at no point provides clear reasoning as to why the combination of prior art relied upon in the prior art rejections of record would not render the claimed invention obvious. Once more, at face value the arguments to Shan represent a piecemeal analysis of the prior art references of Shan and Besser.

Of note it appears that Appellant argues that the Shan teaches of depositing aluminum at temperatures below 400°C, notably from 350°C-390°C. Therefore it would appear that the argument made is that the aluminum deposition temperature of Shan is outside the deposition temperature of the instant claims.

The rejection has set out to explain why, as a whole, the prior art rejection of record would reasonably lead one of ordinary skill in the art to arrive at the claimed invention.

First, Besser as the primary reference teaches of forming interconnect circuits focusing on the details of the process of forming the metallization stacks. The process including forming a Ti wetting layer, Aluminum layer on the wetting layer and Ti and TiN layers on the aluminum layer. In addition during deposition of the titanium, the system temperature is set so that the titanium reacts with the aluminum during deposition to form $TiAl_3$. The concepts therein being substantially similar to that of the instant application.

Besser does not describe all of the steps of manufacturing an integrated circuit, including photopatterning (shown in Colgan and Shan) and of the insulating layer having openings (shown to be conventional by both Shan and Appellant's admitted prior art, in pages 1 and 2 of the specification).

Are such elements novel in the art of manufacturing integrated circuits? The Examiner asserts that the prior art rejection of record would lead one to conclude that such elements are conventional and obvious modifications to that of Besser.

The mere fact that Besser does not disclose each and every known concept of integrated circuit manufacturing absent reasoning as to why the prior art rejection, which shows such features as being well known in the art, cannot stand on it's own merit as basis for withdrawing the rejection. Stating what Besser fails to teach, with respect to the structure of the integrated circuit features recited in the instant claims, without providing any rationale as to why such features are unobvious over the rejection of record and even more, in view of the application's admission that such features are known in the art (see pages 1-2 of the specification), cannot be construed as a reasonable and convincing rebuttal of the prior art rejection of record.

Therefore it is held that the prior art rejection of record reasonably suggests modifying the teachings of Besser to provide the insulative layer, having openings extending there through and the step of photopatterning the product recited in the instant claims. It is further asserted that the elements pertaining to the insulative layer, having openings extending therethrough and the step of photopatterning the product are

all admitted as conventional aspects in the instant Application which supports the Examiner's position (see pages 1-2 of the specification).

Having established that one of ordinary skill in the art would have found the modifications of providing Besser with an insulative layer, having openings extending there through on which the metallization features would have been deposited and subsequently photopatterned, the prior art rejection of record then sets forth the rational as to why the particular temperature conditions and manipulation of the process temperature conditions as claimed would have been readily apparent to one of ordinary skill in the art given the teachings of the prior art of record.

First, as explained above, the prior art of Besser in view of Marieb reasonably suggest depositing titanium at a preferred reaction temperature of 350°C-450°C to accelerate the chemical reaction between these two constituents to form the requisite TiAl3 discussed in both prior art references.

Therefore there is a base motivation for maintaining the minimum temperature of the system to be 350°C-450°C to optimize the throughput of the system by minimizing the time required to heat and reheat the substrate during various coating stations in the Endura 5500 system of Besser.

Therefore the prior art suggests conditioning the aluminum coated substrate to a preferred temperature from 350°C to 450°C during the titanium deposition and would require the aluminum surface layer to be at this preferred level to accelerate the formation of TiAl3.

With respect to the temperature of the outermost portion of the aluminum layer:

Besser fails to provide significant detail as to the process conditions during the deposition of the aluminum.

The use of a two-step cold and hot aluminum deposition is a known technique described both in the invention of Shan, as well as the background discussion of Shan. While Appellant argues the aluminum deposition temperatures with respect to the invention of Shan, it should be noted that the Examiner is not reliant upon this portion of the Shan teaching, but instead relies upon the background disclosure of Shan to suggest the latter hot deposition step of aluminum. Selection of this temperature, rather than the inventive temperatures of Shan, in the greater scope of the process of Besser will further provide a rational as to why the background disclosure temperatures of Shan would have been the applicable temperatures rather than those in the inventive process of Shan.

With respect to Shan, the background art therein discloses depositing aluminum in a first cold step (around 200°C) and then a second hot step which heats the aluminum to temperatures between 400°C and 500°C to allow the aluminum metal to flow through the grains and form a planar surface (col. 1, ll. 20-48).

In the invention of Shan, this reference teaches of depositing aluminum at temperatures from 300°C-420°C and preferably from 350°C-390°C (col. 7, ll. 31-38). Thus Appellant's argument unduly narrows the full range of temperatures disclosed as useful aluminum deposition temperatures of Shan. At best it would be understood that the preferred range from 350°C-390°C is provided to limit the formation of $TiAl_3$ during

deposition of the titanium (see col. 8, ll. 17-41). But this is by no way limiting to temperature ranges below 400°C.

In presenting arguments with respect to Shan, Appellant fails to appreciate the larger scope of the rejection.

The key issue in determining which aluminum deposition temperatures would have been applicable, relies on the fact that while Shan concerned with limiting or reducing the amount of TiAl3 formed during deposition, Besser clearly prefers the presence of such. Therefore, the particular temperatures of Shan, 300°C-420°C and preferably from 350°C-390°C for the outermost portion of the Aluminum layers would not have been desired during the deposition process of Besser because it would not have promoted the formation of the TiAl3 layer. Rather, according to the background art of Shan a cold/hot deposition of the aluminum and most notably for the hot deposition from 400-500°C for the outermost portion of aluminum would have been desired since it would have improved the improved the reflow of the aluminum within the features of the integrated circuit (Shan) and provided higher temperatures for the aluminum to promote accelerated reaction between the titanium and aluminum to form TiAl3 (Marieb).

In depositing the aluminum layer of Besser, it would have been obvious to deposit the outermost layer of the aluminum in a temperature range from 400-500°C to improve the reflow of the aluminum within the features of the integrated circuit.

Both Besser and the instant application employ the same Endura 5500 deposition system. Thus the rate of transfer of the wafers being the same and

traversing the same chamber distances would be sufficiently short such that, while some cooling of the aluminum coated substrate might occur (having been deposited at the suggested temperature from the background art of Shan in a temperature range from 400-500°C), given the high deposition temperature range and short down time between coating steps, the temperature of the substrate would expectedly still exhibit a temperature only somewhat lower than the lower limit of the aluminum outermost layer deposition step and therefore be sufficiently high enough to be at least about 360deg C at the onset of coating the titanium onto the aluminum.

Given the fact that Marieb discloses that deposition of the titanium layer is performed in a preferred range from 350-450°C, this further suggests having the temperature of the substrate be at least 350°C to provide for the accelerated reaction between the just-deposited aluminum and the titanium layer.

Given the relative relationships of the temperature conditions in each of Besser, Marieb and Shan to arrive at the claimed invention, considering that the end process temperature of the aluminum deposition would have been from 400-500°C and the titanium deposition process would have been in a preferred range from 350-450°C, one could reasonably arrive at the conclusion then that it would have been obvious to prevent the aluminum coated layer (deposited at the higher temperature range of 400-500°C) to fall below 350°C since it would have presented the aluminum-coated substrate to the titanium deposition chamber to deposit the titanium at a preferred process temperature for the accelerated reaction of the aluminum and titanium to form TiAl3. And by such accelerated reactions, reduce the processing time for a given

substrate and thereby increase the throughput (number of substrates processed in a given amount of time) of the manufacturing process.

In conclusion, the Examiner and Appellant have taking significantly different approaches with respect to the claims and interpretation of the prior art references relied upon in the rejection of record. It is the Examiner's position that the prior art rejection of record and rationale set forth therein provides a reasonably and logical combination from the teachings therein to render the claims obvious. It is furthermore the Examiner's position that Appellant has presented clear and reasonable arguments with respect to the manner in which the references are presented in the combination set forth in the rejections of record. Appellant instead appears to have taken a piecemeal analysis of the prior art and prior art rejections of record failing to provide any substantive arguments pertinent to the particular prior art rejections of record.

For at least these reasons, the Examiner maintains the prior art rejections of record.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Gregg Cantelmo Gregg Cantelmo

GREGG CANTELMO
PRIMARY EXAMINER

Primary Examiner

Art Unit 1745

Conferees:

Patrick J. Ryan

Supervisory Patent Examiner

Art Unit 1745

Steven P. Griffin

Supervisory Patent Examiner / Conferee

Art Unit 1731